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Towards an Ontology of Religious and Spiritual Belief

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Abstract. Realist ontologies claim to represent what exists. However, human behaviour and culture is deeply influenced by religious and spiritual belief, whose veracity is highly controversial. Such beliefs are nevertheless known to have substantial impact on well-being, social behaviour, health and disease. It is therefore desirable to be able to represent beliefs within a principled ontology using the Web Ontology Language (OWL) as a standardised representation language. This paper demonstrates how a realist ontology, expressed in description logics, can deal with such entities without requiring consensus about their existence in reality. We present several ontology design patterns which allow for taxonomically arranging elements of religious or spiritual belief systems. This provides a framework on which data on particular beliefs can be better standardised for research in humanities, social research and life sciences.

Keywords. Realist ontologies, description logics, propositions, non-denoting terms, design patterns, religious belief, humanities

1. Introduction

Religious and spiritual beliefs have always played a central role in human culture. Their impact on human behaviour is undeniable, and correlations between spiritual beliefs and states of physical and mental health, as well as with risks for delinquency have been shown [1,2,3]. However, such studies tend to operationalize the complex phenomenon of religiosity and spirituality by simple proxy variables like church membership or specific religious practices, which bring in confounding effects.

A systematic account for the area of religious or spiritual beliefs (and disbeliefs) can thus support empirical studies on the influence of such attitudes. Detailed and standardised data about religion and spirituality also benefits adjustment and monitoring of (mental) health care, as well as the identification of risk groups. For these reasons, we outline an ontology of religious and spiritual belief, inspired by a series of posts to the BFO-DISCUSS mailing list [4]. We will give a first account on representational patterns for such an ontology, rooted in Good Ontology Design principles [5,6]. For convenience, we use BioTopLite (BTL2) as an upper-level domain ontology [7], linked to BFO [8]. BTL2 provides a rich set of constraining axioms to enforce the consistency of ontologies modelled thereunder.

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The main challenge of our endeavour is that many of the terms used in discourse related to religion and spirituality have a dubious reference. Ontological realism [9] demands that, e.g., ontology classes always correspond to matching *universals* [10], which are considered existing in their instances. This would preclude non-instantiated universals. Representing religious terms as universals would therefore imply strong commitments to specific religious "truths", thus precluding any sharable ontology across representatives of different (dis)beliefs. From a perspective of formal logics, however, there is no impediment of creating ontology classes that do not correspond to universals, or classes that have no instances. [11]. Based on Description Logics (DL) [12] and using the W3C standard (OWL) [13], so-called defined classes (that are introduced by full definitions but do not necessarily correspond to universals) are already used in several OBO Foundry ontologies like OBI [14].

In [15], the problem of dubious reference was addressed by using fully defined classes in DL ontologies to serve as semantic correlate for non-referring terms like "manned mars mission". The form of the pattern is given by formula (1), with D being a defined class like *MannedMarsMission*, C a dependent continuant like a plan, a disposition or a representational entity, and **rel** a relation like realization or representation:

$$C \text{ equivalentTo } G \text{ and } \mathbf{rel } \text{only } D \tag{1}$$

A defined class MannedMarsMissionPlan can, e.g., be introduced as follows:

 MannedMarsMissionPlan equivalentTo btl2:plan and btl2:represents only
 (2)

 (MarsMission and 'btl2:has participant' some Human)

As dubious reference is not limited to empty classes; the pattern can also be used where some terms may be non-referring in a particular case such as in [16]. E.g., some instances of *CancerDiagnosis* are false ones, i.e. they do not represent any individual entity in the patient to whom the diagnosis is ascribed:

CancerDiagnosis equivalentTo Diagnosis and (3) btl2:represents only (Cancer or not HealthCondition)

Briefly, reference to class-level entities by means of DL value restrictions is a mechanism to include expressions where no consensus exists about their being instantiated. In the following, we will present modelling examples, from which we derive adapted design patterns, addressing the representation of narrations and (possibly divine) characters, as well as religious and spiritual attitudes².

2. Survey of Domain Entities

Probably more than in any other domain the existence of key entities of discourse is subject to controversy when it comes to religion and spirituality. There is no consensus about the existence of deities in particular, or about the very notion of a spiritual, immaterial level of reality in general. While theists and atheists are in dispute about the existence of Gods, others disagree regarding the number of Gods and their causal

² All modelling examples, together with additional ones, are implemented as an OWL file, importing the upper-level ontologies BFO and BTL2 (<u>http://purl.org/biotop/orsb.owl</u>). The data artefact provided is, at its current stage, only a demonstrator ontology intended as a proof of concept. It is not ready to serve as a full domain ontology.

involvement with the world. Even closely related religious denominations disagree about the historical veracity of narratives, or about the validity of ritual speech acts. Contentious entities include demigods, angels, ghosts, devils, and souls; places like Walhalla or the Purgatory; named persons or animals who play a role in religious narratives (Moses, Cerberus, Mahomed); qualities and dispositions ascribed to persons and objects (being holy, immortal etc.); and events, the existence of which is claimed by religious narratives (creation, transubstantiation, the final judgement, or transfiguration).

Nevertheless, both popular and scientific discourse in this area is possible, and religious studies do not necessarily presuppose an agreement on the existence of certain entities. Consequently, an ontology of religious and spiritual belief should allow taking a fundamentally agnostic stance: it should, e.g., neither claim nor deny that a God exists.

Consensus should, however, be assumed for (i) actions like asserting, confessing, denying, worshipping, forgiving, absolving, beatifying, together with their human participants; (ii) material objects that participate in religious acts, or to which supernatural qualities are ascribed (bread and wine in Eucharist, celestial bodies in sun cults); (iii) belief and disbelief as mental attitudes of humans; (iv) social entities, like churches, religious groups, spiritual communities etc.; (v) religious roles, such as the role of a priest; (vi) classifications of people according to their religious and spiritual beliefs or disbeliefs; and (vii) religious and spiritual texts and narratives, together with the names occurring in them (like "Abraham", "Krishna", or "Holy Trinity").

3. Modelling Patterns

Modelling religious belief faces several challenges. First, we need to be clear about *what* religious beliefs are: Are they psychological phenomena of individuals? Or are they abstract objects, e.g., propositions of religious content? This question is connected to the question *whose* beliefs we have to model: The beliefs of individual believers or institutional acknowledged religious statements? Or are we to model religious texts and their content, or religious ceremonies and rituals? For most of these candidates, there is a common denominator: We deal with mental or textual representations with a religious or spiritual content. It is, however, debated whether religious belief or faith, is a system of propositional attitudes or specific kind of emotion, e.g. "feeling of absolute dependence" [17]. Without taking an ultimate stance on the true nature of religion, it is this cognitive side of religious belief that we want to model.

Given this aim, two OBO ontologies seem to be relevant, *viz.* the Mental Functioning Ontology (MF) [18] and the Information Artifact Ontology (IAO) [19]. In MF, as a psychological phenomenon, a religious belief can be seen as a *Cognitive representation*, i.e.: "A representation which specifically depends on an anatomical structure in the cognitive system of an organism" (MF_0000031). According to MF, cognitive representations are *specifically dependent entities*. They depend on the (human) individual that has them as part of their mental outfit. (A corollary of this definition is that disembodied souls like Cartesian egos, or souls in the Hades, due to their lack of anatomy, cannot have any *MF:Cognitive representation*.) From the IAO point of view, we need to decide whether beliefs should be seen as information content entities or, more generally as representations. IAO information content entities are conceived of as actually being about some 'portion of reality'. The **is_about** relation in IAO 'is a (currently) primitive relation that relates an information artifact to an entity' (IAO_0000136). Subrelations of **is_about** are **denotes** (IAO_0000219) and **mentions** (IAO_0000142: 'An information artifact *IA* mentions an entity *E* exactly when it has a component/part that denotes *E*'). Now a lot of human talk and human beliefs share the fate of religious belief as being 'about' (in the non-IAO sense) things that are (i) not known to exist, or that are even (ii) known not to exist. As a solution for the first part of this problem, Ceusters and Smith [9] suggest to use a modified version of the more generic notion of *MF:Representation*, as a quality that **is_about** or is *intended* to be about a portion of reality.

3.1. Narrations, Characters and Ascriptions

In our domain, many terms of dubious reference are meant to denote not classes but individuals. Even if there is a consensus about their existence, their status and deeds might be controversial (e.g. their divine nature or whether they effected miracles). From a Realist scenario, representations of such individuals would be prohibitive, as long as there is no consensus about their existence. We can use names and the narratives in which they occur as weak identity criteria and try (4) as a tentative formulation; the resulting defined class can then be used like the expression D in (1):

AbrahamHuman equivalentTo Human (4) and 'btl2:is represented by' value AbrahamName and 'btl2:is represented by' value Genesis12–25

The class AbrahamHuman makes the representation of discourse about the biblical prophet Abraham possible, without committing us to assume that it has a "real" Abraham as member. Alternatively, we can represent the characters featuring in the respective narrative by introducing Character as a subclass of 'btl2:information object' or, alternatively, MF: Representation, if it is given the revised definition discussed above. We restrict our model to those entities where there is a consensus about their existence, as discussed in Section 2. Taking the Abraham example, there is no disagreement that the name 'Abraham' exists, that this name is intended to denote a man, that it is used in religious narratives, and that some of these narratives are contained in Genesis 12–25. Characters like this are neither physical nor mental ones, but they have a history: There is a first time they feature in a narrative; their narratives can develop and be forgotten about. Like companies [20], characters could, in a first approximation, be characterised as quasi-abstract entities. Characters are coined by one or more human authors; they may feature in one or more texts by the same author or by different authors. They may or may not be coined to fit to a historical person. Importantly, we have to distinguish (following [21]) between features that are properties of characters and features that are ascribed to characters. Characters may have properties like being the main character of a story, being more or less elaborate, and so on. E.g., the character Abraham has the property of being told about in chapters 12-25 of the book Genesis.

'btl2:is part of' (AbrahamCharacter, TheBookGenesis) (5)

In addition, characters are objects of predicate ascriptions. E.g., being married to Sarah is ascribed to the character Abraham; it is not a property of the character Abraham, as only human persons can marry, but not quasi-abstract characters. The relation between a character and its originator is given by the originator of the narrative:

(6)

'btl2:is part of' (CerberusCharacter, DivinaCommedia)

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DivinaC (Autho	ommedia type <i>Narrative</i> and 'btl2:is outcome of' some oring and 'btl2:has agent' value DanteAlighieri)	(7)

A character is also related to its possible real-world counterpart (8):

AbrahamHuman EquivalentTo Human and	(8)
'btl2:is represented by' value AbrahamCharacter	

This pattern yields a class-like expression, used to relate to the character Abraham without asserting his real existence. This is done via the class *AbrahamHuman*, which expresses the intensional content of reference to Abraham, e.g., in the expression of belief or doubt. Its extension is either empty or equals exactly one member, i.e., the historic Abraham, if there is one. Further attributions can be added, e.g., that Abraham is married and male. Strictly spoken, this is not possible for information content entities like characters; however, **AbrahamCharacter** is asserted as a member of a class-level statement, which includes an intensional description of the properties ascribed to him:

```
      AbrahamCharacter Type Character and btl2:represents only (Human and (9)
      (9)

      ('btl2:is bearer of' some MaleQuality) and
      (9)

      ('btl2:is bearer of' some (Name and 'btl2:has value' value Abraham"^xsd:string)) and
      (9)

      ('btl2:is agent in' some Marrying))
      (10)
```

This means that if the Abraham character represents something, then the real, historic correlate is a married man called "Abraham". This approach is, however, vulnerable to the criticisms brought forward by, e.g., Kripke [22] and Donnellan [23] against the so-called Frege-Russell approach to singular terms, as it could, e.g., be the case that Abraham has not been married, or has not been called "Abraham".

Characters feature in texts; they are, we will say, parts of texts. Texts have authors; so characters are invented by whoever first wrote a text that featured this character.

Authoring equivalentTo btl2:process and ('btl2:has agent' some	(10)
('btl2:is bearer of' some AuthorRole)) and ('btl2:has outcome' some Narrative)	

Narrative subclassOf 'btl2:information object' and	(11)
'btl2:is outcome of' some Authoring	

Character subclassOf 'btl2:information object' and (12) ('btl2:is part of' some Narrative) and (btl2:represents only (btl2:organism or SupernaturalContinuant))

The action of an author is not limited to the creation of characters in a narrative, but also the ascription of properties to them (cf. Formula 9). Ascriptions may vary between narratives and authors. E.g., the fictional character Cerberus features not only in Dante's masterwork, but also in much older sources, e.g. from Ovid and Virgil, from which it differs regarding the number of heads. Ascription is modelled as follows:

```
Ascribing subclassOf btl2:process and ('btl2:is part of' some Narrating) and (13) ('btl2:has agent' some ('btl2:is bearer of' some AuthorRole)) and ('btl2:has patient' some Character) and ('btl2:has outcome' only P)
```

with P corresponding to a class-level character predication in the style of (9). In addition to the relations discussed, there are the attitudes of readers towards these characters. Of particular importance is whether it is assumed that there is a real-world correlate to a certain character or not.

3.2. Beliefs and Deities

There are several views on how to represent beliefs [24]. As a disposition, a belief can be realized by being asserted as part of a personal justification or by specific acts. It is, however, not the act of realization, which defines a belief but its propositional content. How the two are linked is subject to debate, e.g., how beliefs are mentally represented. In the following proposal, B is a class-equivalent term for some object of belief. Then the class of belief dispositions for B can be characterized as follows:

Belief_B subclassOf BeliefDisposition and 'btl2:inheres in' some(14)('btl2:is bearer of' some (BeliefProposition and btl2:represents only B))

This allows to model, e.g., beliefs in immortal souls (21):

 BeliefPropositionThatImmortalSoulsExist equivalentTo BeliefProposition and (btl2:represents only (Soul and ImmortalContinuant))
 (15)

The belief in some deity is a socio-cultural feature to classify people into atheists, agnostics, and believers. It is therefore important whether people think that there is a real-world correlate of the divine characters, i.e., that there is at least one God. The problem here is twofold: (i) a consensus that some God exists cannot be reached, and (ii) a full definition of what it is to be a God is impossible, because there is no common conception of God(s) across religious denominations. We solve this problem by remaining on the class of characters, and introduce the class *God-Character*, defined as those characters that are in their respective narratives ascribed the feature of being a God. There is, of course, the problem which non-English terms will serve as equivalents of the English term "God". This is, again, related to the problem of the contesting conceptions of God(s). Given this background, the class *GodCharacter* seems to be deemed to be remain extensionally vague. In practice, however, we can populate this class with characters like **ChristianGodCharacter**, **ZeusCharacter**, **KrishnaCharacter**, etc.

By means of the class *GodCharacter* we can account for various classifications of persons according to their religious beliefs. An atheist is someone who considers all instance of the class God characters as non-referring, while deists and theists in the wide sense consider some instance of the class God character as having a real-word counterpart. We can go on and model specific conceptions of God, such as the deist and theist conceptions of God:

 DeistGodCharacter equivalentTo GodCharacter and btl2:represents only
 (16)

 ('btl2:is agent in' some ((Creating and 'btl2:has outcome' some btl2:universe)
 or not CausalIntervention))

 TheistGodCharacter equivalentTo GodCharacter and btl2:represents only
 (17)

 ('btl2:is agent in' some
 (Creation and 'btl2:has outcome' some btl2:universe)) and

('btl2:is agent in' some (*CausalIntervention* and not *Creating*))

Introducing beliefs as belief propositions, we can then model, e.g. a *Theist* in the following way, refraining from any explicit reference to a *God* class:

 Theist equivalentTo Human and 'btl2:is bearer of' some
 (18)

 (BeliefProposition and (btl2:represents only
 ('btl2:is represented by' some TheistGodCharacter)))

Thus, the intensional content of the *Theist*'s belief proposition is precisely the referent of the *TheistGodCharacter* from formula (17).

4. Discussion and Outlook

In the current paper, we tested a representational pattern suggested in [15] and [16] by applying it to religious and spiritual belief, a domain where it is controversial whether central general terms as well as proper names are actually referring expressions, and where multiple incompatible conceptions like "God" co-exist. Fundamental human attitudes like belief or faith are, however, far from being unanimously defined and understood. For instance, while our and the approach of the *Mental Functioning Ontology* (MF) converge in regarding beliefs as dispositions, MF has a problem with representing false beliefs [25]. Similarly, in the Information Artifact Ontology (IAO) reference to some entity in reality is a necessary condition for information content entities. In line with [2], we use the less committing resources of BioTopLite2 to solve these problems.

We were able to extend the patterns from [15] and [16] to create OWL expressions as correlates for terms of dubious reference. However, we have not always been able to model fully defined classes. Instead of introducing classes for contentious entities, we introduced classes for representational entities that are used in religious narratives, and whose existence should be uncontroversial.

There are several limitations of this, admittedly, preliminary approach. First, we have focused on a small selection of modelling challenges only; further work is required to model, e.g., religious communities, roles, speech acts and practices. Second, we do not use first-order logic. This impairs precise definitions in some cases. We see this justified by the need to stick to a computable model that can be used in automatic reasoning and which uses shared language standards and tools. Its restrictive expressiveness, together with the complexity of the domain, bring with it the need for simplification. For instance, cognitive scientists, philosophers and theologians may criticise the lack of addressing the distinction between "to belief in" and "to belief that", as well as the rather sketchy treatment of terms and matters of religion, which may be considered a rather uninteresting contribution to these domains. Finally, our work also needs to be delimited from computer science accounts of belief, such as belief networks, where strengths of belief are quantified. This is not addressed here, although strengths of belief also might be an issue in religion. However, a formal representation of belief systems of machine agents might follow our modelling patterns presented here.

The relevance of this work reaches beyond the realm of religion and spirituality, as terms of dubious reference cannot be ignored, wherever beliefs, hypotheses or plans need to be represented. The problem is pertinent to domains like developmental and cognitive sciences, but also to psychology, psychiatry, and health care, which need to describe the intensional content of thoughts, beliefs, wishes and delusions of patients. E.g., children may believe that dolls are animated, delusional patients may believe that they were abducted by extra-terrestrials; and the belief in the effectiveness of therapy (including placebo) is a strong principle of cure. In the domain of Law, e.g., legal contracts may refer to warranties for possible liabilities resulting from the occurrence of specified kinds of future events, which could be expressed as intensional class statements along the lines suggested here. Finally, our approach could also be applied to literary studies, in which fictional characters and their properties need to be represented; this, however, would require a refinement of our theory of ascription.

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